Space Weather Technical Forecast

Issued on Saturday 22 March 2025 at 00:37 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2; Minor-Moderate radio blackouts) throughout. G1-G2/Minor-Moderate Storms likely Day 1 (22 Mar), with a chance of G1-G2 Days 2-4 (23-25 Mar), due to HSS and/or CME influences.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity reached Moderate levels following an isolated M1.2 flare at 21/1558UTC, from AR4028 in the southwest.

There are currently fourteen sunspots on the Earth facing disc, thirteen numbered and one un-numbered. Despite the large amount of sunspots, the vast majority are relatively small and magnetically simple and either stable or in slight decay. AR4031 is the largest group, located toward the northwest limb. Two other newly numbered bipolar groups have also rapidly emerged in the northwest quadrant in recent hours.

A faint partial halo CME was observed from near centre disc following the M1.2 flare from AR4028 at 21/1558 UTC. This is currently being analysed, but seems likely to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, were between background and slightly elevated levels until around 21/1700 UTC, after which it increased steadily 450-550 km/s. Density was often above average, but decreased erratically after 21/1700 UTC. Interplanetary Magnetic Field, Bt, was initially weak but increased steadily to moderate levels, before becoming persistently strong after 21/1700 UTC, with brief peaks of very strong, maximum 40nT. The north-south component, Bz, followed a similar pattern to the IMF, later becoming strongly variable +33nT to -20nT. Phi angle was negative (towards the sun) until 21/0420UTC, at which point it rotated positive (away from the sun). A further rotation back to the negative sector was observed around 21/1600 UTC. Geomagnetic activity was Quiet to Active (Kp 1-4), then increased to G1/Minor Storm 21/1800-2400 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background levels. High energy electron flux (greater than 2 MeV) was at background to moderate levels. The 24-hour fluence was below the Active threshold. The observed integrated pfu was 1.01e7 at 22/0000 UTC.

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Four-Day Space Weather Forecast Summary

Solar Activity: Generally Low activity is expected, with a chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: Further potential glancing CME influences mean that confidence in the forecast is lower than usual.

Solar winds are expected to continue at enhanced slightly elevated to elevated levels, initially from ongoing CME influence, then later due to anticipated connection with CH24/- in the western hemisphere. There is also potential for another CME glance later Day 1. Enhanced winds are likely to persist into Day 2 (23 Mar) before perhaps easing into Day 3 and 4 (24 and 25 Mar). However, later on Day 4 (25 Mar) the large CH25/+ may begin to become geo-effective, increasing solar winds again.

G1-G2/Minor-Moderate storms are likely on Day 1 (22 Mar), with a chance of further G1-G2 periods on Days 2-4 (23-25 Mar) due to HSS and/or further possible CMEs influences.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background levels, with a slight chance of enhancement from any larger flares. High energy electron flux is expected to continue at largely background levels until later in the period. Electron (1e8 integrated pfu) fluence should remain below the Active threshold throughout the period.

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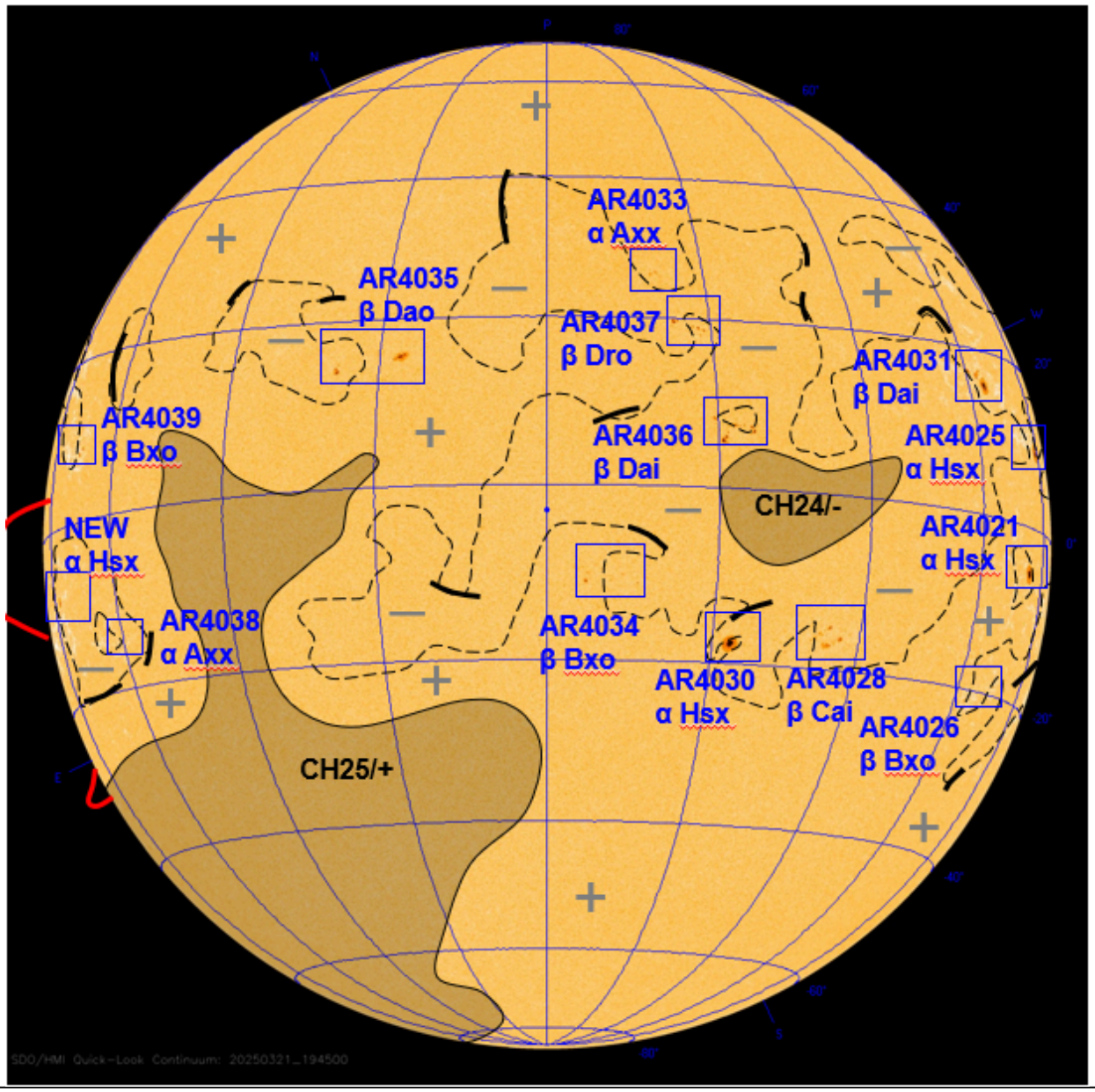
Figure 1: Synoptic Map valid 21/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A weak CME arrived overnight, reaching L1 at 21/0141UTC which was likely in association with a filament eruption to the northeast of the disc early on the 18th of March. A further, stronger enhancement then developed after 21/1700UTC, which may have been a separate CME but this is uncertain.

A CME which was observed leaving the Suns NE limb early on 19 Mar, possibly as a result of a filament eruption from the north-centre disc that occurred around 19/0034 UTC. This has been analysed and results in ENLIL suggest a potential glancing blow at Earth late on Day 1 (22 Mar). Over the past few days there has been evidence of some weak eruptions from near centre disc, most notably a filament eruption around 20/1800UTC. However, there was no clear CME in coronagraph imagery so this has been omitted from the forecast, however it does not rule out the possibility of a weak transient CME over the next few days. More recently, a faint partial halo CME was observed from near centre disc following the M1.2 flare from AR4028 at 21/1558 UTC. This is currently being analysed, but seems likely to have an Earth-directed component. Given these potential CME influences, confidence in the forecast is lower than usual.

Solar winds are expected to continue at enhanced slightly elevated to elevated levels, initially from ongoing CME influence then later due to anticipated connection with CH24/- in the western hemisphere. Enhanced winds are likely to persist into Day 2 (23 Mar) before perhaps easing into Day 3 and 4 (24 and 25 Mar). However, later on Day 4 (25 Mar) the large CH25/+ may begin to become geo-effective, increasing solar winds again.

G1-G2/Minor-Moderate storms are likely on Day 1 (22 Mar), with a chance of further G1-G2 periods on Days 2-4 (23-25 Mar) due to HSS and/or further possible CMEs influences.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	80	50	50	40
Strong	**G3**	No	20	10	10	5
Severe	**G4**	No	5	1	1	1
Extreme	**G5**	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
19/1121	Partial	Filament Eruption	North-centre	635	22/1900	Glancing blow from shock possible.

Figure 2: Latest MOSWOC Enlil.

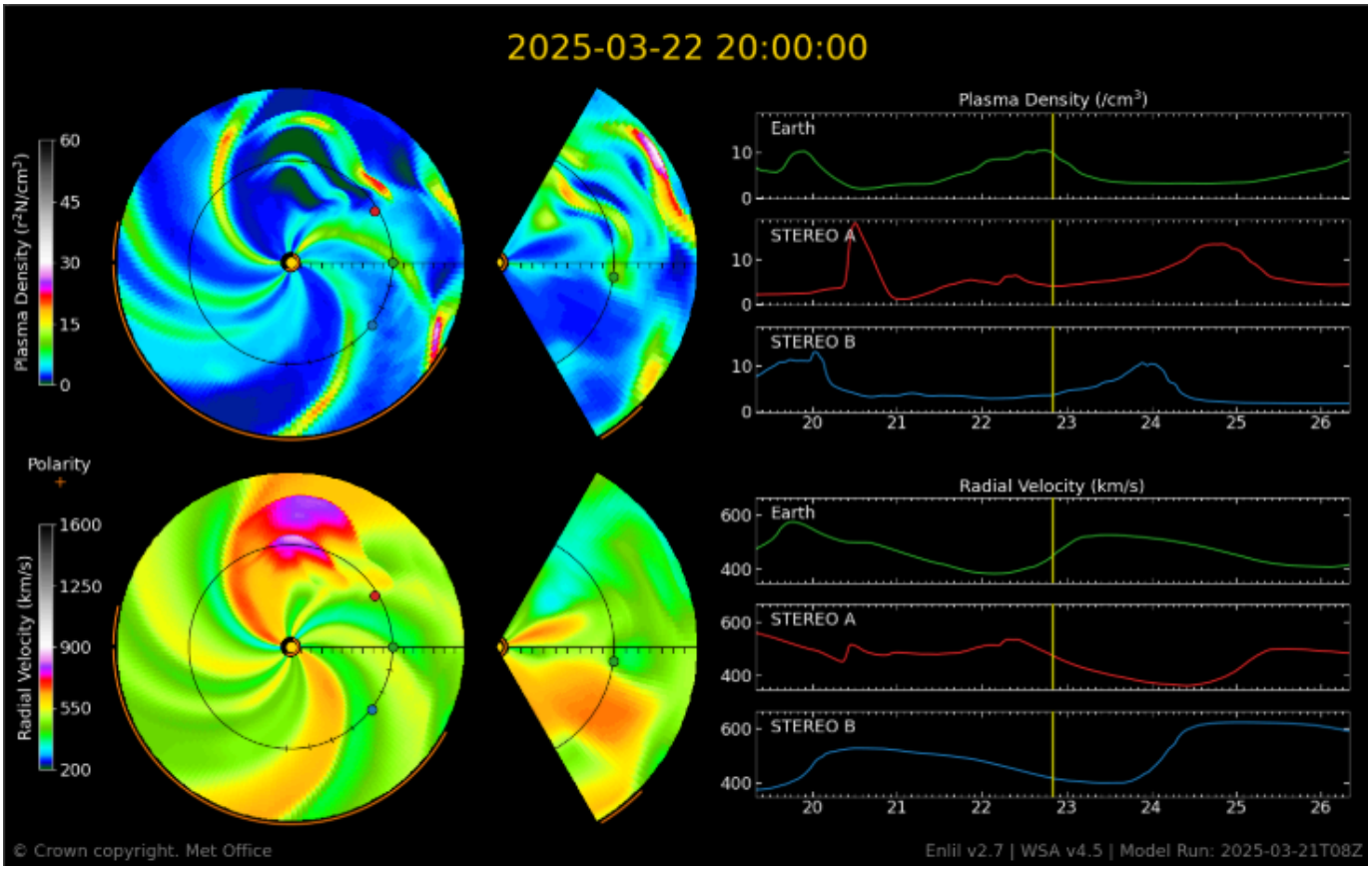

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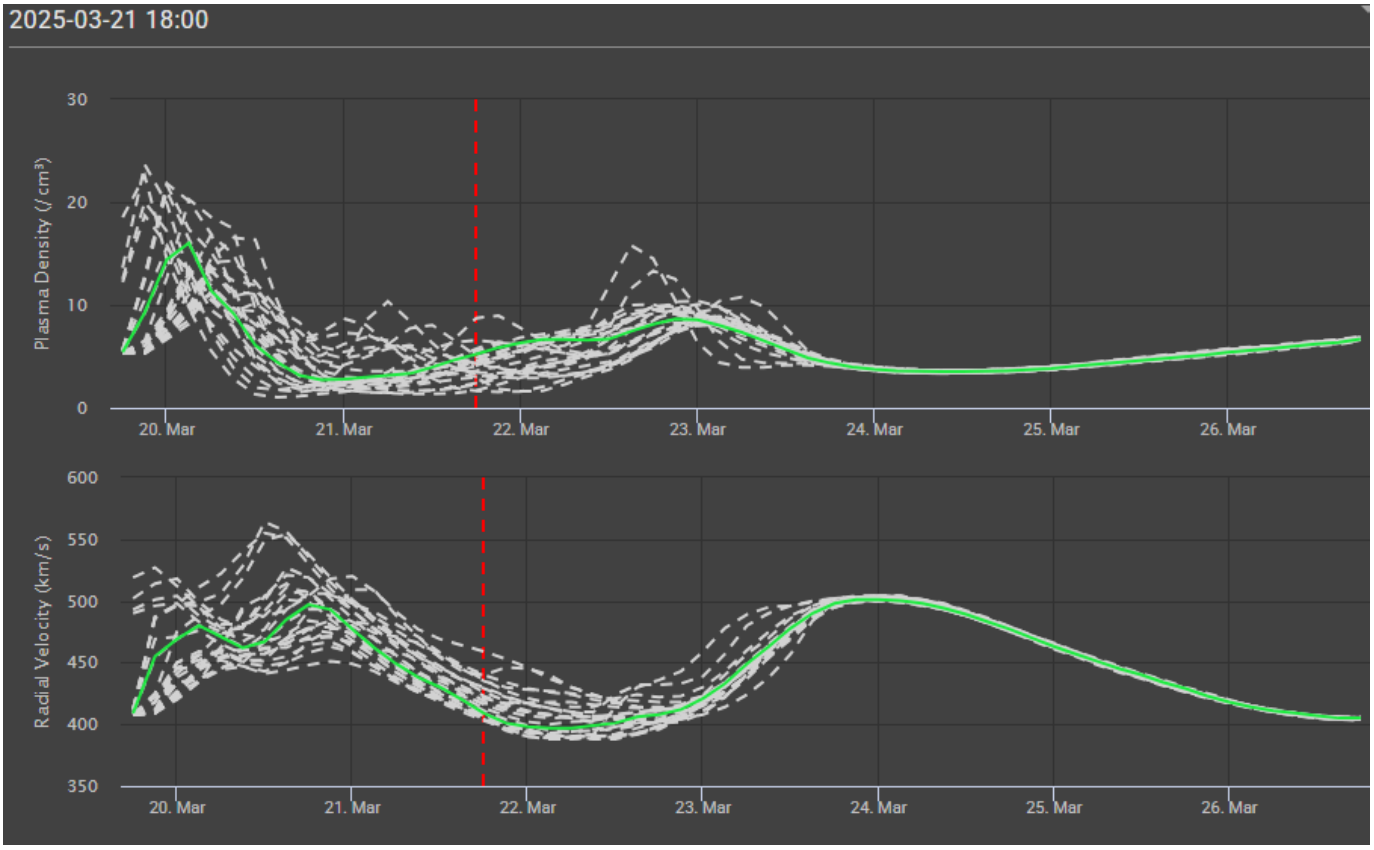
Figure 3: Latest MOSWOC Enlil ensemble.



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Radio Blackouts - X-Ray Flares

Solar activity reached Moderate levels following an isolated M1.2 flare at 21/1558UTC, from AR4028 in the southwest.

There are currently fourteen sunspots on the Earth facing disc, thirteen numbered and one un-numbered. Despite the large amount of sunspots, the vast majority are relatively small and magnetically simple and either stable or in slight decay. AR4031 is the largest group, located toward the northwest limb. Two other newly numbered bipolar groups have also rapidly emerged in the northwest quadrant in recent hours.

Generally Low activity is expected, with a chance of further isolated M-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	35	30	30	30
Very Active	R3-R5 (X Class)	No	1	1	1	1

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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background levels, with only a slight chance of enhancement due to the current lack of large, complex spot groups on the Earth facing disc.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

GOES16 High energy (>2MeV) Electron flux was at background to moderate levels, peak 960 pfu at 21/1440 UTC . With possible weak CME arrivals over the next few days, most likely late on the Day 1 (22 Mar), flux levels are expected to remain at largely background until later in the period after the arrival of the HSS from CH24.

MOSWOC REFM shows the electron fluence should remain below the Active threshold throughout the remainder of the period, and is considered reasonable guidance, albeit with low confidence as a slightly increasing trend towards the end of the period is possible.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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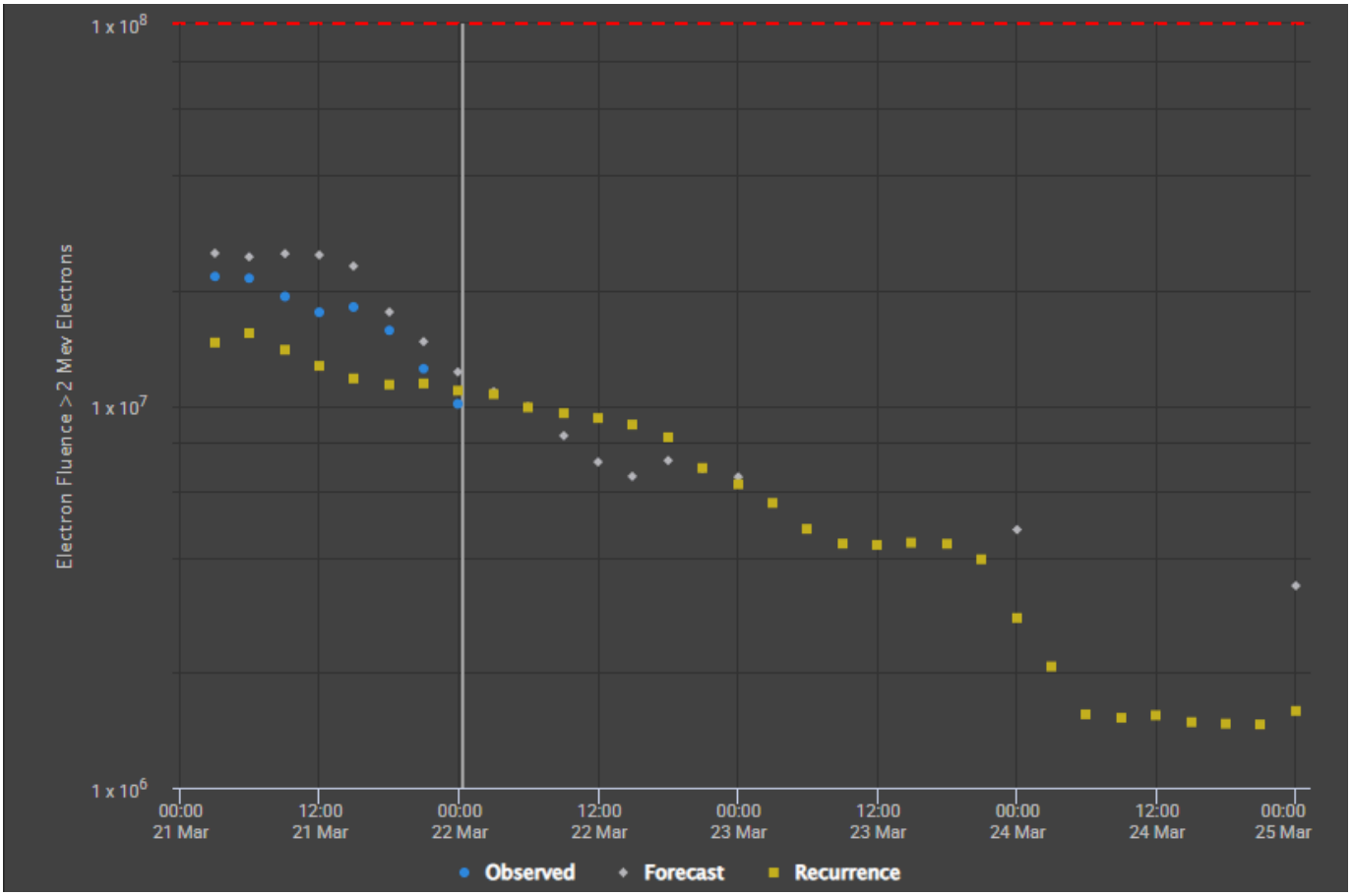
Figure 4: MOSWOC REFM model.



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